FIG. 1

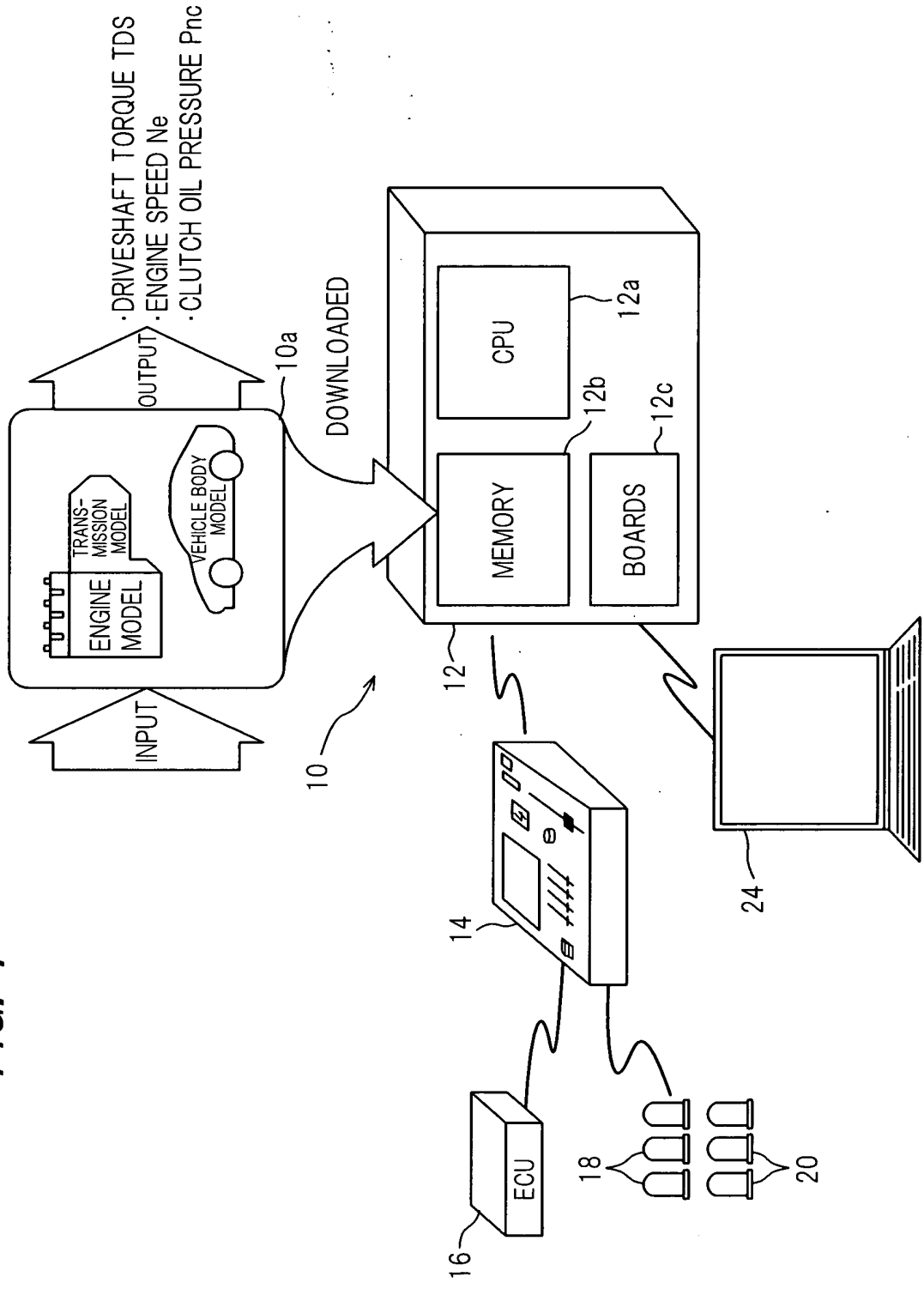

·DRIVESHAFT TORQUE TDS
·ENGINE SPEED Ne
·CLUTCH OIL PRESSURE Pnc
OUTPUT
INPUT
10a
ENGINE MODEL
TRANS-MISSION MODEL
VEHICLE BODY MODEL
DOWNLOADED
10
12
CPU
12a
MEMORY
12b
BOARDS
12c
14
16
ECU
18
20
24

FIG. 2

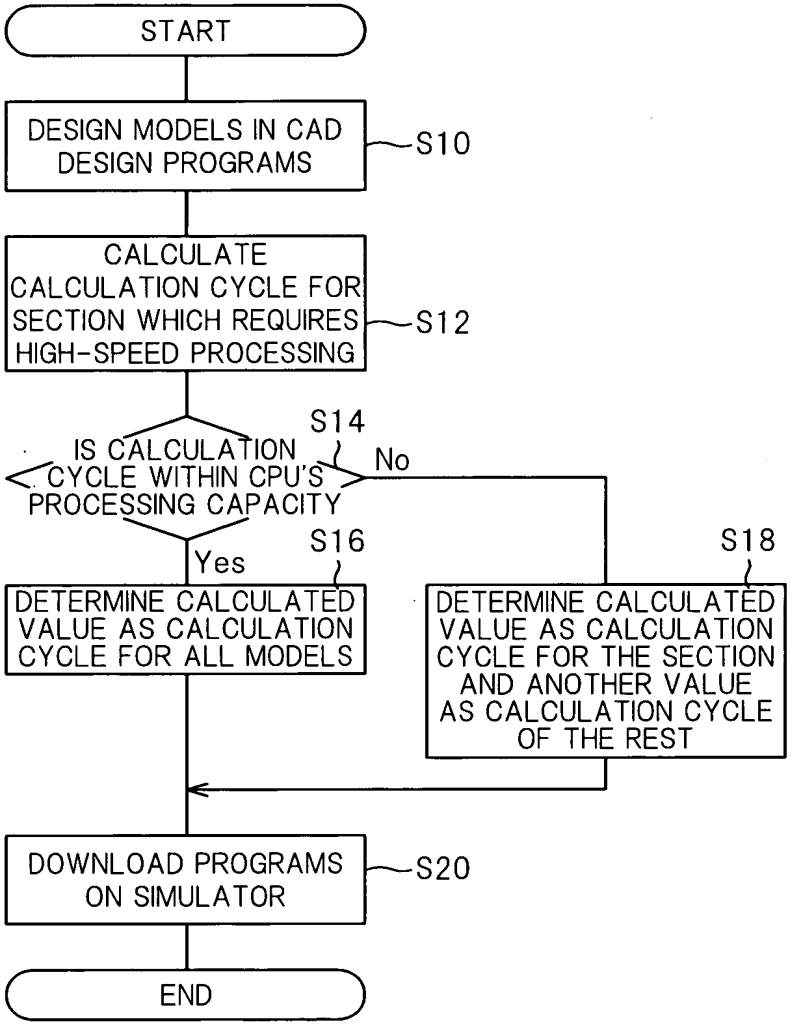

START
DESIGN MODELS IN CAD DESIGN PROGRAMS
S10
CALCULATE CALCULATION CYCLE FOR SECTION WHICH REQUIRES HIGH-SPEED PROCESSING
S12
S14
IS CALCULATION CYCLE WITHIN CPU'S PROCESSING CAPACITY
No
Yes
S16
DETERMINE CALCULATED VALUE AS CALCULATION CYCLE FOR ALL MODELS
S18
DETERMINE CALCULATED VALUE AS CALCULATION CYCLE FOR THE SECTION AND ANOTHER VALUE AS CALCULATION CYCLE OF THE REST
DOWNLOAD PROGRAMS ON SIMULATOR
S20
END

FIG. 3

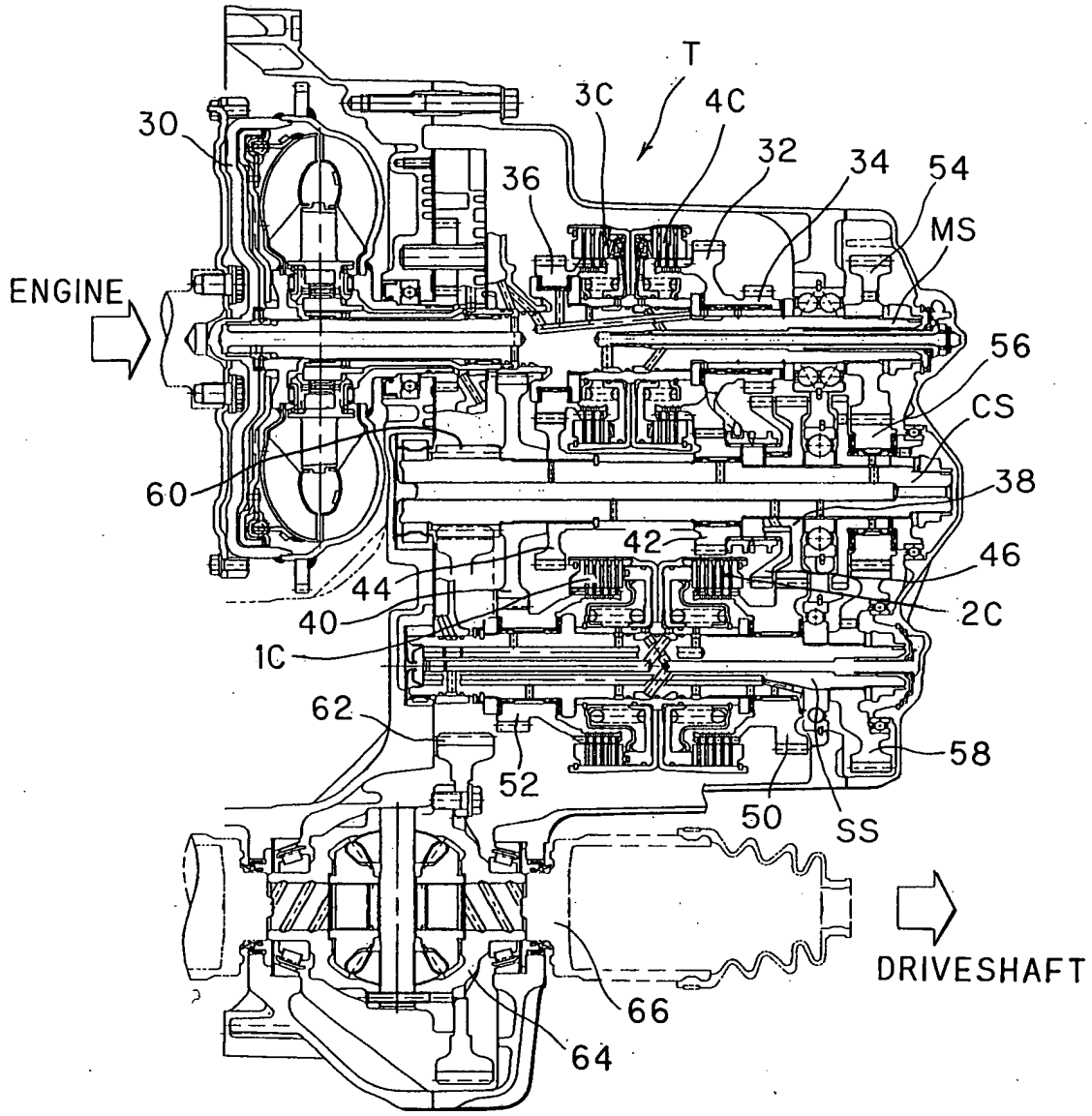
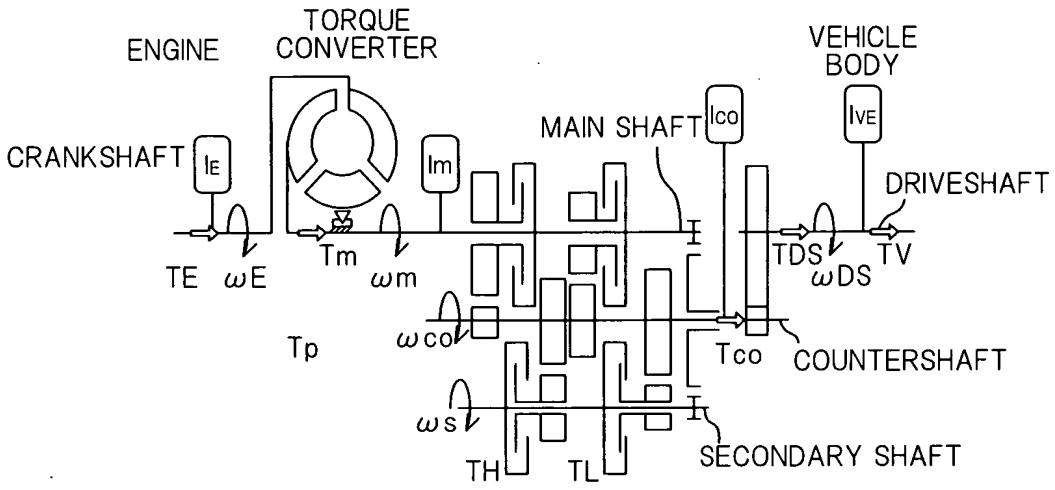

T
3C
4C
30
32
34
54
36
MS
ENGINE
56
CS
38
60
42
46
44
40
2C
1C
62
58
52
50
SS
DRIVESHAFT
66
64

FIG. 4



ENGINE	$TE-Tp-IE\cdot\dot{\omega}E=0$	(1)
TORQUE CONVERTER	$Tp=\tau(\dot{\omega}E/1000)^2$	(2)
	$Tm=\kappa\cdot Tp$	(3)
MAIN SHAFT	$Tm-TL-TH-Im\cdot\dot{\omega}m=0$	(4)
COUNTERSHAFT	$Tco-TL\cdot iL-TH\cdot iH+Ico\cdot\dot{\omega}co=0$	(5)
DRIVESHAFT	$TDS=Tco\cdot iF$	(6)
	$TDS-TV-IDS\cdot\dot{\omega}DS=0$	(7)

TRANSITION AL SHIFT PHASE

PHASE	MAIN SHAFT		COUNTER SHAFT	
LOW-GEAR DRIVE	$Tm=TL$	(8)	$Tco=Tm\cdot iL$	(9)
TORQUE PHASE	$Tm=TH+TL$	(10)	$Tco=Tm\cdot iL-TH\cdot(iL-iH)$	(11)
INERTIA PHASE	$Tm=TH-Im\cdot\dot{\omega}m$	(12)	$Tco=TH\cdot iH$	(13)
HIGH-GEAR DRIVE	$Tm=TH$	(14)	$Tco=Tm\cdot iH$	(15)

IN THE ABOVE,
TL:HIGH-GEAR CLUTCH TRANSMISSION TORQUE AND
TH:LOW-GEAR CLUTCH TRANSMISSION TORQUE

FIG. 5

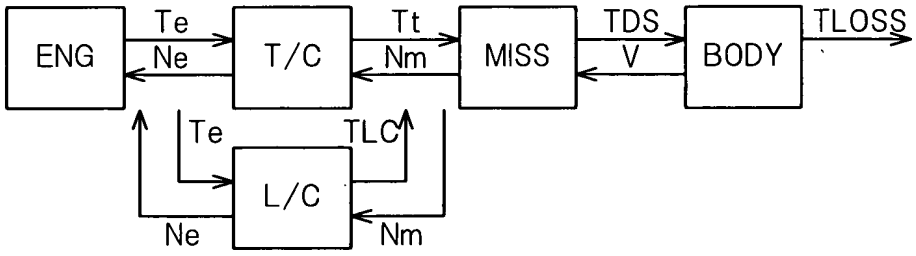

ENG
Te
Ne
T/C
Tt
Nm
MISS
TDS
V
BODY
TLOSS
Te
TLC
L/C
Ne
Nm

FIG. 6

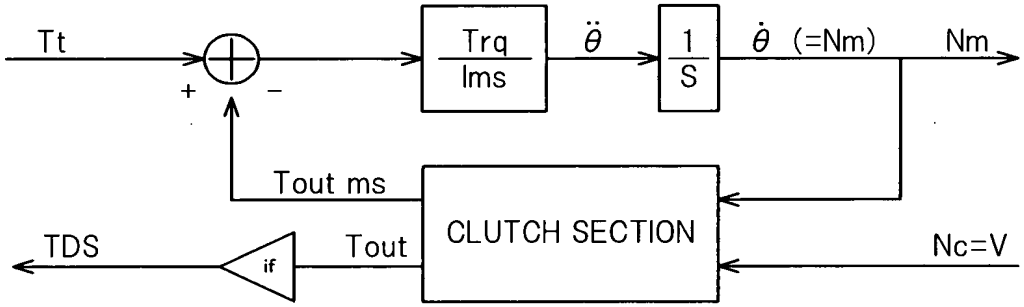

Tt
+
−
Trq
Ims
θ̈
1
S
θ̇ (=Nm)
Nm
Tout ms
CLUTCH SECTION
TDS
if
Tout
Nc=V

FIG. 7

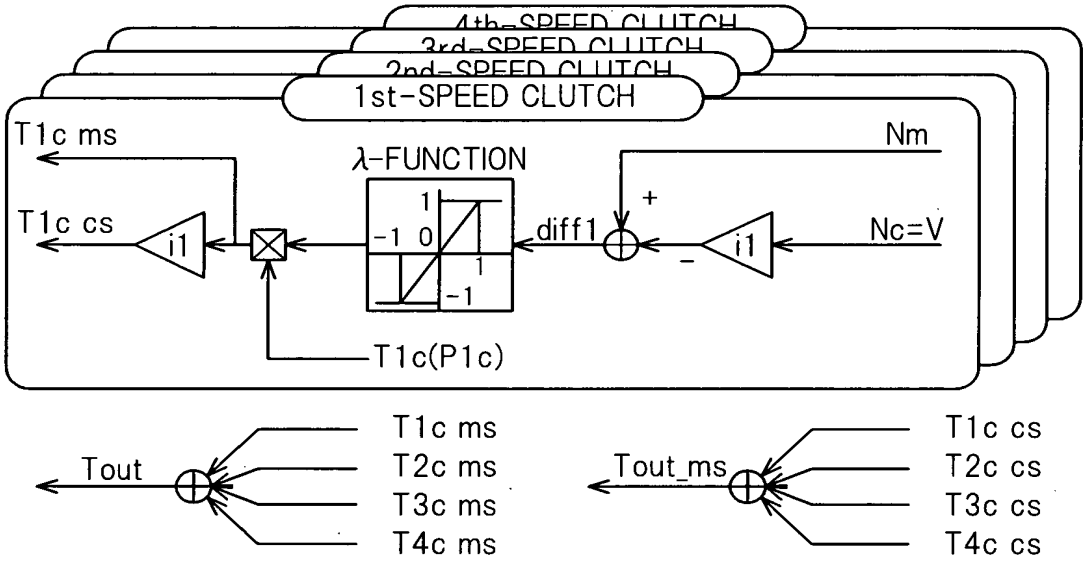

4th-SPEED CLUTCH
3rd-SPEED CLUTCH
2nd-SPEED CLUTCH
1st-SPEED CLUTCH
T1c ms
Nm
λ-FUNCTION
T1c cs
i1
1
-1 0
1
-1
diff1
+
-
i1
Nc=V
T1c(P1c)
Tout
T1c ms
T2c ms
T3c ms
T4c ms
Tout_ms
T1c cs
T2c cs
T3c cs
T4c cs

FIG. 8

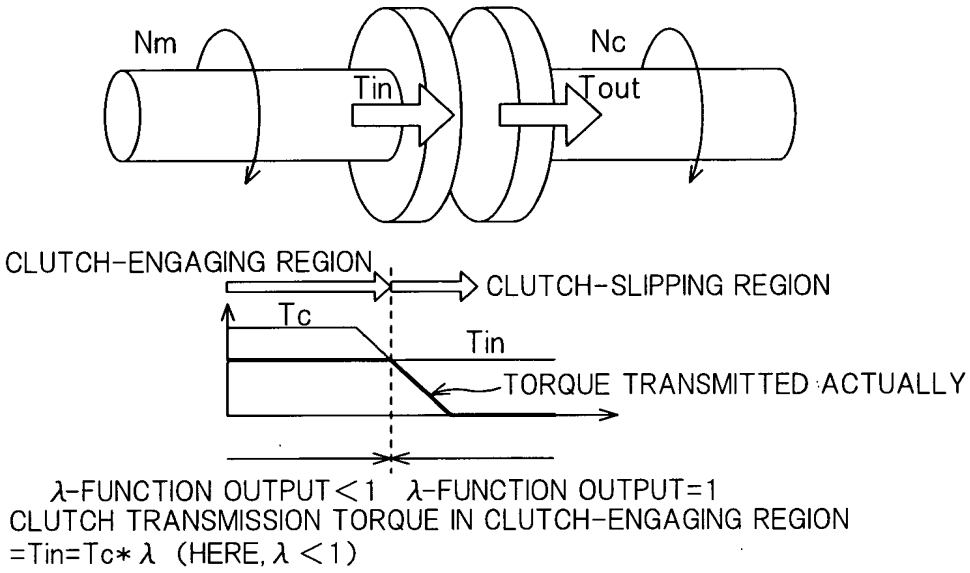


FIG. 9

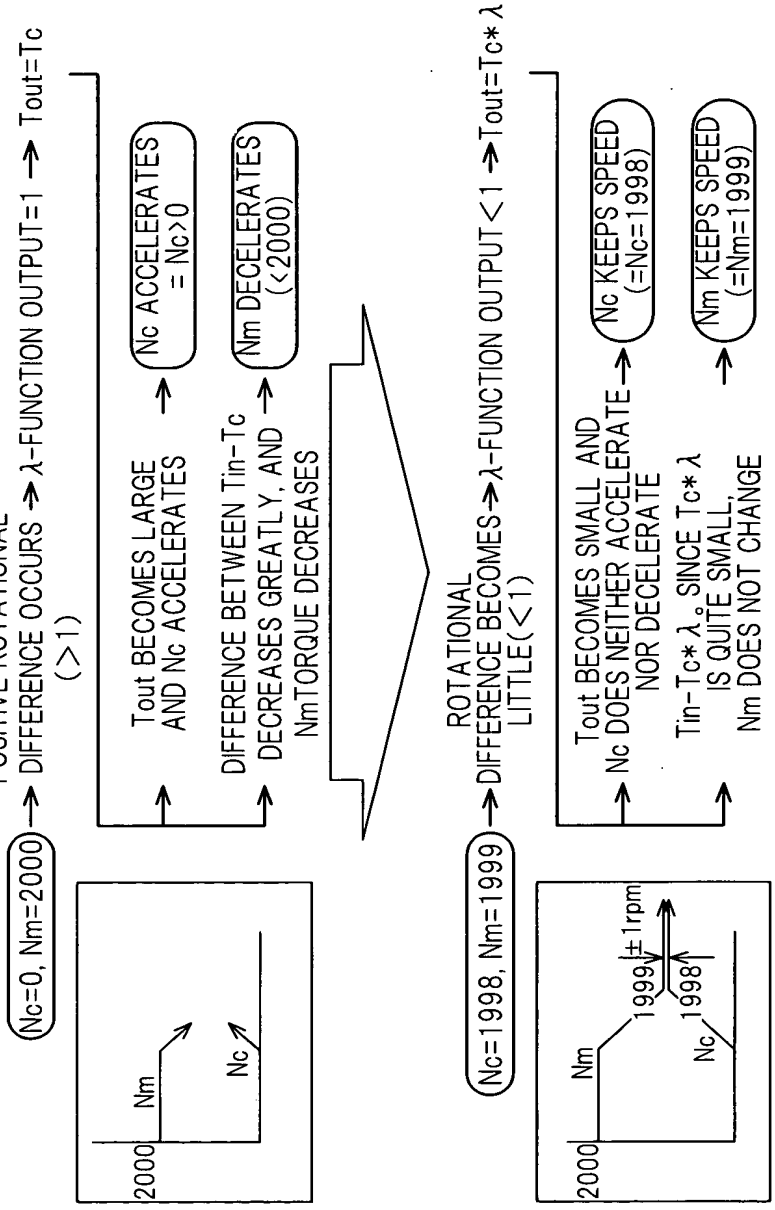

POSITIVE ROTATIONAL
Nc=0, Nm=2000
DIFFERENCE OCCURS
(>1)
λ-FUNCTION OUTPUT=1
Tout=Tc
Tout BECOMES LARGE AND Nc ACCELERATES
Nc ACCELERATES = Nc>0
DIFFERENCE BETWEEN Tin-Tc DECREASES GREATLY, AND NmTORQUE DECREASES
Nm DECELERATES (<2000)
2000
Nm
Nc
ROTATIONAL
Nc=1998, Nm=1999
DIFFERENCE BECOMES LITTLE(<1)
λ-FUNCTION OUTPUT<1
Tout=Tc*λ
Tout BECOMES SMALL AND Nc DOES NEITHER ACCELERATE NOR DECELERATE
Nc KEEPS SPEED (=Nc=1998)
Tin-Tc*λ SINCE Tc*λ IS QUITE SMALL, Nm DOES NOT CHANGE
Nm KEEPS SPEED (=Nm=1999)
2000
Nm
1999
±1rpm
1998
Nc

FIG. 10

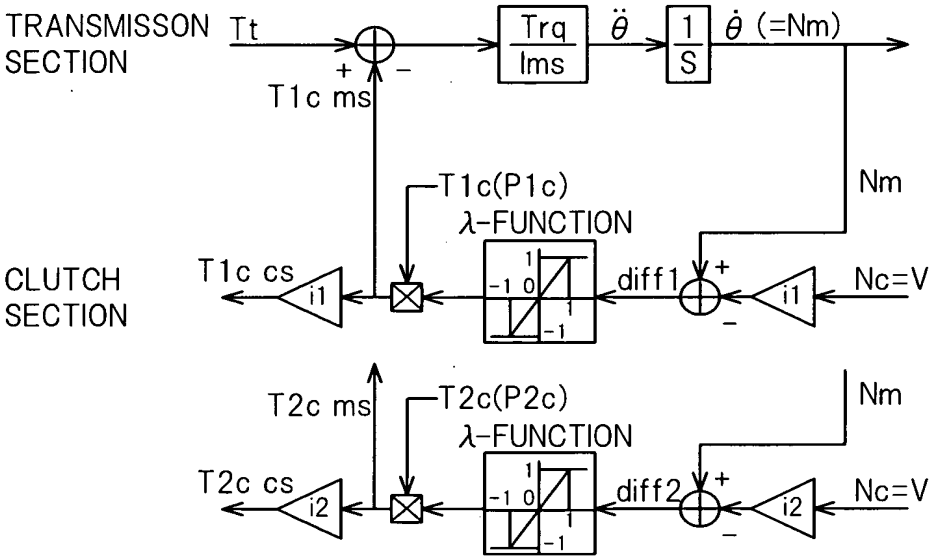

TRANSMISSON SECTION
Tt
+
−
T1c ms
Trq / Ims
θ̈
1 / S
θ̇ (=Nm)
Nm
T1c(P1c)
λ-FUNCTION
CLUTCH SECTION
T1c cs
i1
diff1
+
−
i1
Nc=V
T2c ms
T2c(P2c)
λ-FUNCTION
Nm
T2c cs
i2
diff2
+
−
i2
Nc=V

FIG. 11

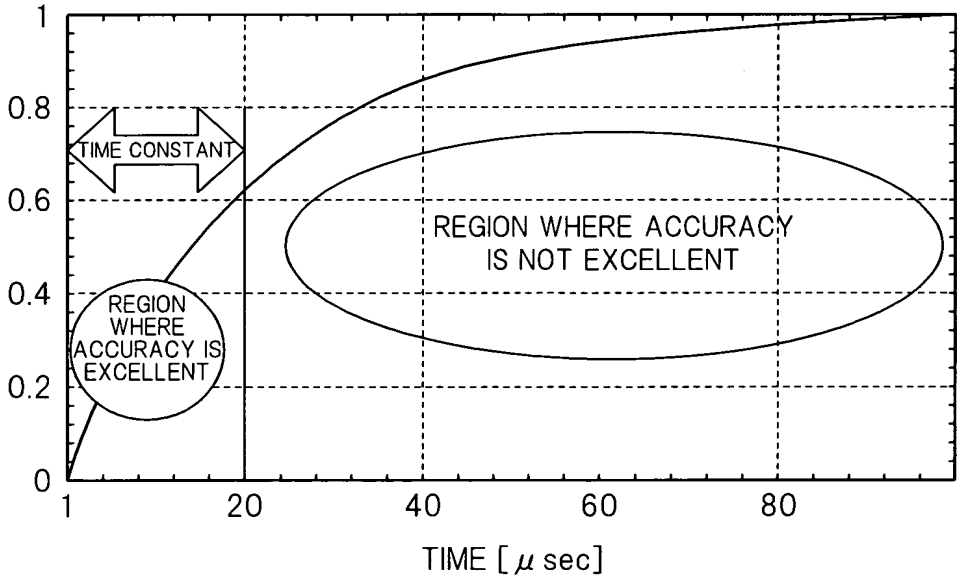
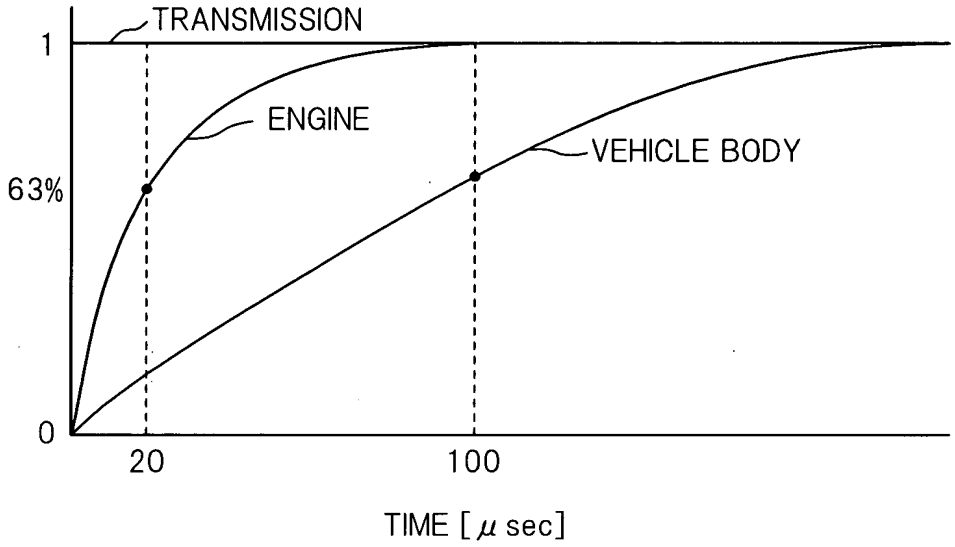

1
0.8
0.6
0.4
0.2
0
TIME CONSTANT
REGION WHERE ACCURACY IS NOT EXCELLENT
REGION WHERE ACCURACY IS EXCELLENT
1
20
40
60
80
TIME [μ sec]

FIG. 12



ENGINE INERTIA=0.3kgf·m^2
TRANSMISSION INERTIA=0.007kgf·m^2
VEHICLE BODY INERTIAL(CONVERTED)=130.5kgf·m^2

FIG. 13

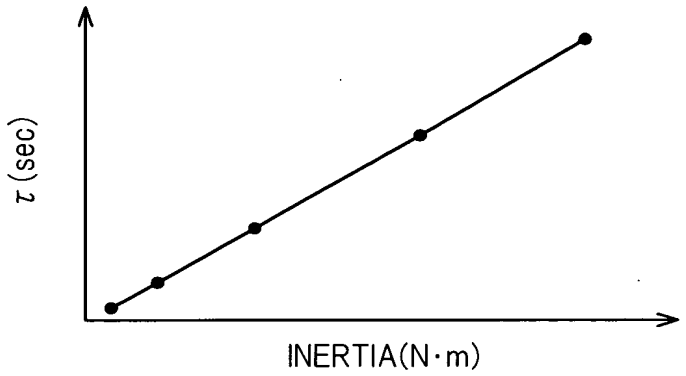


FIG. 14

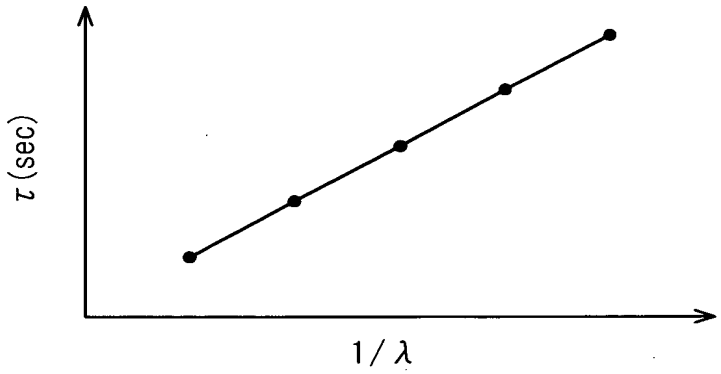


FIG. 15

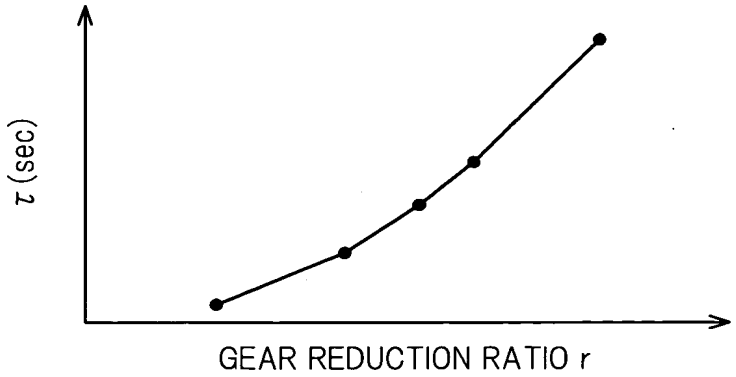


FIG. 16

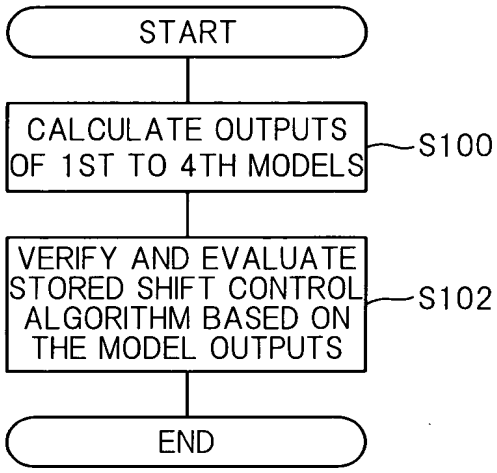

START
CALCULATE OUTPUTS OF 1ST TO 4TH MODELS
S100
VERIFY AND EVALUATE STORED SHIFT CONTROL ALGORITHM BASED ON THE MODEL OUTPUTS
S102
END

FIG. 17

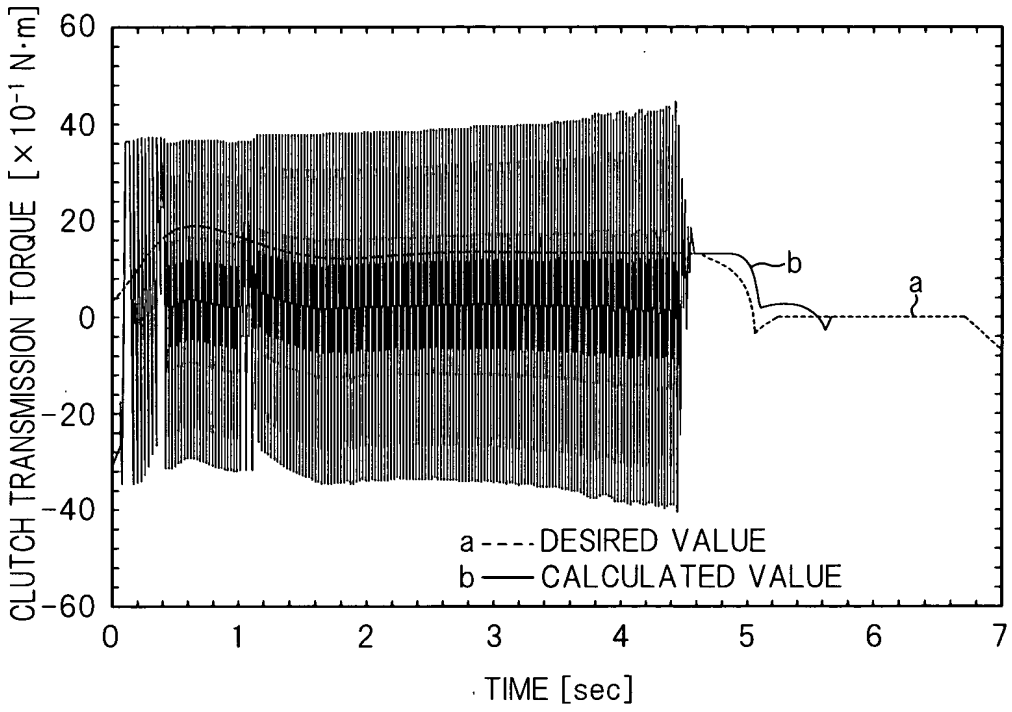
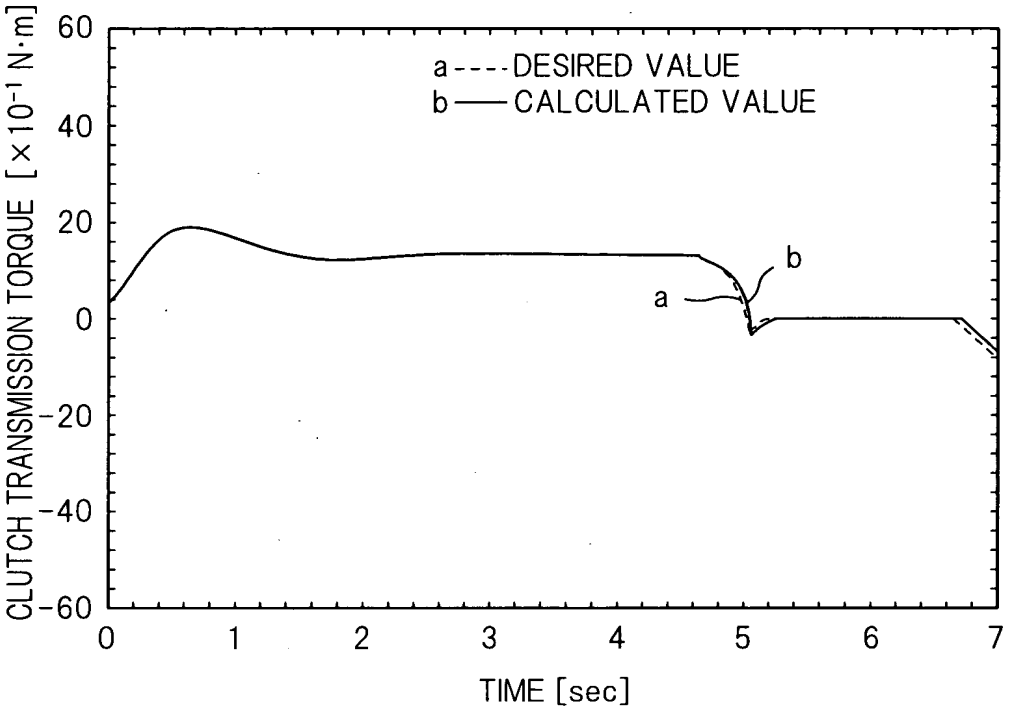

CLUTCH TRANSMISSION TORQUE [×10⁻¹ N·m]
60
40
20
0
-20
-40
-60
0
1
2
3
4
5
6
7
TIME [sec]
a
b
a ---- DESIRED VALUE
b —— CALCULATED VALUE

FIG. 18


a----DESIRED VALUE
b——CALCULATED VALUE
CLUTCH TRANSMISSION TORQUE [×10⁻¹ N·m]
60
40
20
0
-20
-40
-60
0
1
2
3
4
5
6
7
TIME [sec]
a
b

—:ACTUAL VALUE、----:CALCULATED VALUE

th=WOT

FIG. 19A

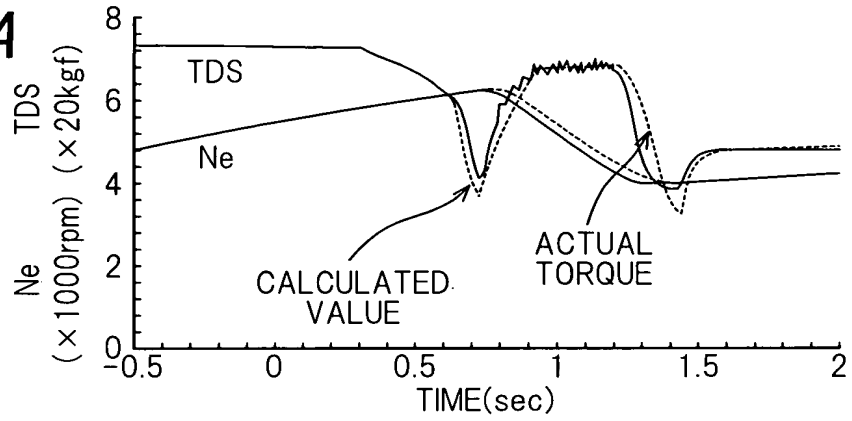


FIG. 19B

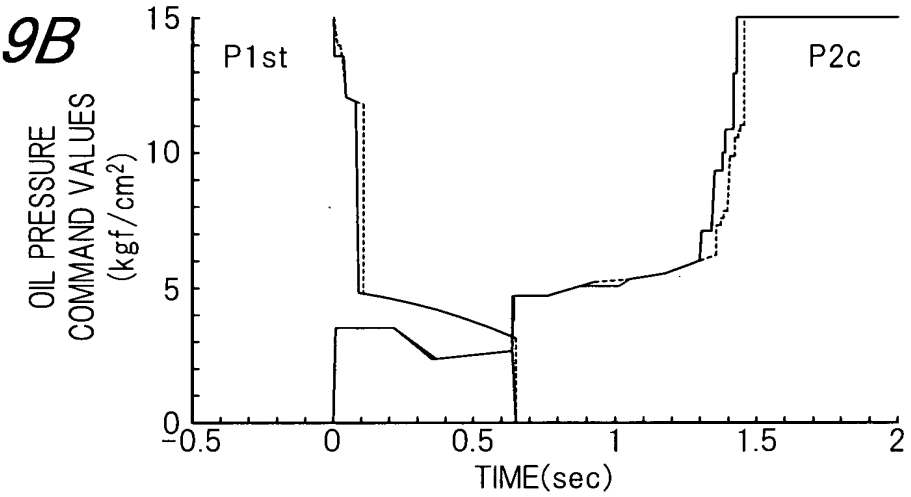


FIG. 19C